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Review article ■

On Economic Evaluation of Health Care

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SUMMARY

Starting from reduced definition of health in terms of absence of disease and invalidity, the paper explains the applicability of three cardinal principles of economics (scarcity of resources and imperative of choice, opportunity costs, marginal analysis) on extremely sensitive area of economic evaluation of health care.

An attempt was made to recognize the strengths and identify objective limitations of most used methods of economic evaluation of health care. The paper concentrates on recognizing the main problems at the same time by abstracting many details.

Key words: health, health care, economic evaluation, efficiency, righteousness

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INTRODUCTION

Over the last fifty years, health care costs in almost all market economies had tendency of expansion growth, in absolute amount and are relatively compared to the value of the gross domestic product. The assumption that after the initial large investment in health, the share of health care costs in GDP gradually decrease and stabilize at 5% proved to be unsustainable. Moreover, it is more evident that numerous factors like the application of new medical equipment, development of pharmacotherapy, extension of life expectancy and similar, causes continual increase of health care costs. Generally speaking, a powerful scientific and technological progress, apposed to the influence in many other spheres of human activity, in area of health care has not caused a reduction, but continual increase of health care costs.

Continual growth of costs has caused more serious discussion on the economic effects of health care. The perception of the results in this area is increasingly being approached in the light of the economic criteria of efficiency, despite the indisputable fact that the issues of economic evaluation of phenomena such as illness and health, by definition, are always accompanied by a number of ethical dilemmas. Absence of clear views regarding cost structures on the one hand, and monetary quantification of health outcomes, on the other hand, in the long run has resulted in making incompetent decisions in this area. However, recently, more sophisticated methods of supporting the application of economic evaluation of health care have appeared. In final instance, despite the vast number of emotional debates as a result of attempts to express the monetary value of human life, the view that the economic evaluation of health care is necessity and that it is a socially meaningful activity, no matter how much from an ethical point of view this was problematic, is now widely accepted in science and in practice (1).

Criteria of economic evaluation of health care can not be the only variety in decision-making in health care. However, it is safe to claim that it is an unavoidable dimension of all decisions that directly or indirectly relate to the allocation of available resources in this area. Therefore, recognizing the strengths and identifying objective limitations of most used methods of economic evaluation is in a function of not only raising the efficiency of allocation of limited resources in health area but also in improving the quality of functioning of entire health care system.

The application of any of the known methods of economic evaluation of health care shows the importance of the two moments. The first concerns the necessity of understanding the logic of the application of key concepts of economic analysis in health care. It is clear that without that the understanding of logic of basic economical principles in health care it is not possible to be competent to judge the categories of costs and out-

comes whose movement is of crucial importance for economic evaluation of health care. The second factor relates to the perspective from which the economic evaluation of health care is realized. Namely, it is necessary to make a distinction between microeconomic (level of individuals and health organizations) and macro-economic approach (community level).

Evaluation of health care in light of imperative of understanding the logic of key concepts of economic analysis

Economics is the study of alternative use of scarce resources. The key concepts of economic analysis whose knowledge is essential in economic evaluation of health care are: a) scarcity and choice, b) opportunity costs and c) marginal analysis (2).

One of the cardinal principles of economics refers to the view that resources that a society has at a given time are limited. Limitation of resources means that their use in a certain way means denying of many other potentially possible ways of use. Making a certain decision always means losing a possibility to use resources in terms of doing something else. It is beyond dispute, namely, to live in a world of limited resources and that there is no possibility of simultaneously meeting the needs of all people. In other words, it is necessary to meet different needs with limited resources, which always raises the question of their actual use. Often, the choice is difficult, even an unpleasant activity.

Related projects in various spheres of human life are competing for available resources. There is also a competition of different use of possibilities within each of the many areas of social life. For example, investments in prevention of cardiovascular disease can jeopardize realization of health care programs for children of school age, physical examination of employees at the mines; it can make impossible the realization of stool blood testing program in order to detect colon cancer, etc.

The primary tasks of economic evaluation of health care are associated with identifying, evaluating and comparing the relevant costs and outcomes. Economic evaluation of health care is *per se* (in itself) the activity of comparative character. It is always about comparative analysis of alternative activities that involve different costs and outcomes (3). Therefore, there must be at least two alternatives, or interventions whose costs and outcomes are compared with each other. As a rule, one does not compare the procedure or intervention with a solution that does nothing, unless it is an understandable option. By observing the costs and outcomes, decision-makers are in fact searching for an optimal way to use available resources by trying to pre-

serve and improve the health of individual patients, group or community as a whole.

The value of goods or services which were denied by some individuals because they have opted for another form of consumption in economics is related to the concept of opportunity cost. The concept of opportunity costs is especially valuable in determining the analytical instruments in determining non-market values of goods, exactly such is the health of humans, which represent a highly valuable good, although it is not selling and buying on the market.

The opportunity cost represents the value of the second-best use of economic good, actually the value of sacrificed alternative. It is about measuring of that which was abandoned when the decision was taken on the actual use of resources. In the perception of the concept of opportunity cost in a complex processes of economic evaluation of health care it is very important to note the difference between cost categories of coverage in the accounting and economic terms. The costs in economic terms are a far broader category as it includes not only the explicit outlays of money, but also opportunity costs that arise because resources can be used in alternate ways (4).

Marginal analysis is of crucial importance in the economic evaluation of health care. During its application of special importance are the results of comparing the relationship between marginal cost and marginal output. The ratio of marginal funds invested in a marginal intervention and outcomes of intervention generally does not have a linear character. To explain the importance of marginal analysis in economic evaluation of health care, as an example can be used the American Cancer Society Recommendations saying that in order to detect the colorectal cancer, stool samples must be tested six times to the presence of blood. Practice has shown that the sixth test result compared with the fifth was a very small increase in detection of new cases, making the current issue of profitability of number of testing. It turns out that the costs of each newly discovered case of colon cancer by taking the sixth stool sample for blood traces are about 47 million dollars. (5).

The nature and results of economic evaluations of health care can vary significantly depending on the perspective from which it is implemented, i.e. depending on the level from which are perceived the costs and outcomes. Specifically, the individual components of costs and outcomes of health care are very different depending on whether the quantification of their size is approached from the perspective of patients, physicians, or from perspective of health institutions, health insurance funds, or society as a whole.

Outcomes in health care are benefits which individuals have, but of course if it is not about externalities that are a result of applying preventive programs (immunization, for example).

Micro-economic evaluation of health care

The decision-making in health care use three types of economic evaluations: cost-of-illness study, cost-benefit analyses and cost-effectiveness analyses. Each represents an attempt to compare costs and outcomes of alternative health care activities.

Cost of disease studies

Cost of disease studies have focused on measuring the costs of certain diseases. This implies identical outcomes. Quantifying the costs of the disease provides information on the structure of costs related to disease of specific population in a given geographical area. Since there is no *per se* measure of results, the opinions that it is not a method of economic evaluation of health care in the strict sense of the word are not rare. It provides important information to health policy makers and economists on the costs of certain diseases. It is considered to be the first, undoubtedly a very important step in identifying the costs and time that leads to economic evaluation of health care in the truest sense of the word (2).

Druss et al. (6) examined the economic burden of five chronic disorders of the U.S. population in 1996: behavioral disorders, diabetes, heart disease, asthma and hypertension. Health care costs arising from treatment of these five diseases amounted to 62.3 billion dollars, with heart disease participated with over half of the total costs. Auditors found that the cost of treating health problems arising from the coexistence of these five diagnoses amounted to 207.7 billion dollars. Adding an estimated 36.2 billion dollars of lost wages due to missed work the total health care costs of \$ 270 billion comes to the amount of 306 billion dollars of social costs on the basis of these five listed diseases.

Finkelstein et al. (7) have estimated that the health costs of overweight and obese in the U.S. in 2002 exceeds the figure of 92 billion dollars. Although estimates of costs due to obesity is about 6% of total health spending, research shows that over a third of annual growth of U.S. health spending are related to obesity illnesses: diabetes second type, cardiovascular disease, musculoskeletal disorders, sleep apnea, gallbladder disease and several cancers, including endometrial cancer and postmenopausal breast, kidney and colon. Other studies have examined the costs of illness social costs of AIDS (8) alcoholism, drugs abuse, mental illness (9).

Although the cost of disease study results are interesting, they do not provide answers to questions about the most effective option for treating the disorder. Answers to questions about the optimal allocation of resources can be reached using a different approach to

economic evaluation of health care, or by using analysis of cost-benefit analysis and cost-effects.

Analysis of relationship between costs and benefits (cost-benefit analysis)

Analysis of cost-benefit relationship is a technique that compares all the costs and outcomes expressed in monetary units of some programs or projects. Optimal use of resources requires that each project or program implemented by the public sector has a marginal social benefit that exceeds the marginal social costs. The problem for decision makers in the public sector stems from the circumstances that the information necessary to quantify the marginal social costs and marginal social gain are unknown, making it difficult to determine the social optimum. This method is a practical attempt to provide the optimal choice in health care, or to reach an optimal allocation of resources in the absence of markets, and at the same time to remain in positions of the concept of marginal analysis. Through it can successfully be answered to the question whether it is justified from an economic point of view to realize a particular health action (usually health care program) and that its economic effects are greater in comparison with the effects of alternative health care activities. When the input and output values are expressed in terms of money, it leads to the relation that shows the relationship between costs and outcomes, expressed in money of certain health care activities. Therefore, this method can be applied only in situations where the verification of financial outcomes is possible, without a danger to violate some basic ethical and social norms.

Financial evaluation of human life can be problematic for many, but the monetization of outcomes is necessary to calculate cost-benefit ratio. The technique relies entirely on the premise that the value that is used in decision-making in society is simply the sum of individual values outcomes. As known, the value that individuals determine is based on the price you are willing to pay. Profit is economically valued by using the approach of willingness to pay. The will of the individual to pay for the improvement of health depends on the current health status, life expectancy, the possibility of replacing the present for future consumption (10).

One of the first applications of cost-benefit analysis in health care is a classic study of poliomyelitis by Weisbrod (11). Later, it turned out that the methodology can be applied to a wide range of medical research programs.

In health care in estimating the economic losses due to disease, the question of quantifying these losses is often raised, if the loss of earnings or income per worker represents, for example, a more adequate indicator. There are many contentious moments in terms of spending most appropriate treatment in the assessment of economic losses due to premature death, and

in the process of quantifying the economic value of life. Also, applications of cost benefit analysis in health care face the problem of quantifying the improvement of public health. Given the fact that this method involves the quantification of the financial outcome of health care on one hand, and that the phenomenon of economic evaluation of disease, health and life always carries with it many ethical questions on the other hand, analysis of cost-benefit relationship can be more rarely found in the proceedings of economic evaluation of health care.

Analysis of the relationship between costs and effects

If the improvement of health status level of the given population is the primary objective of health care, it is logical that the outcomes of health care can be expressed as a result of treatment, and not their monetary value. Analysis of the relationship between costs and effects is a way of quantifying the relationship between resources used and outcomes of care achieved without having to express the outcomes of health care in financial form. Its analytical framework is prevalently of economic nature. Most simply, analysis of the relationship between costs and effects is reduced to seeking ways in which you could maximize the possible level of health of given population with limited resources. In this sense, it provides practical guidelines for choosing between alternative health care programs that improves health of the observed population by use of the available amount of funds.

Analysis of the relationship between costs and effects is comparing the size of the costs of different medical treatments and one joint outcome that is different for many health treatments (e.g. reduction in blood pressure, avoidance of hip fracture or extension of life expectancy). Options can be a different treatments for the same health needs, such as kidney dialysis as compared to kidney transplant, or unrelated treatments with joint effects, such as lifesaving cardiac diseases in relation to the final stage of renal insufficiency.

When decision makers are faced with limited budgets, analysis of the relationship between costs and effects provides information on the highest overall health outcomes of observed population. In cases where the most effective option of treatment of some health problem is the cheapest one, the choice is simple. Difficulties arise when the most effective treatment is expensive. Policy makers need objective measures to help determine optimal treatment option.

Costs can be classified as direct and indirect. Direct costs are usually divided into direct medical and direct nonmedical costs. Direct medical costs include costs associated with the use of medical resources. They are usually borne by patients and their families. Indirect costs are costs associated with lost productivity. This includes sick leave, decreased productivity at work and

other losses in productivity due to early retirement or premature death. However, there is a broad group of the so-called intangible costs. In short, they are linked to reduced quality of life. These costs include pain and suffering, sorrow, anxiety. As it is difficult to measure, these costs are often neglected.

Outcomes are the measured improvements of population health status. They can be expressed in the form of surrogate measures, intermediary or final measures. Surrogate measures examined the clinical effects of treatment options and its clinical efficacy; this can be expressed in terms of high blood pressure, cholesterol, bone density or tumor size. Indirect measures can be expressed in the events, such as a heart attack, stroke, hip fracture, cancer remission or death. Final results are measuring economic effectiveness and can be expressed in the events avoided, cured infection, disease-free days, extended years of life or additional years of better quality of life.

In general, clinical results, surrogates and indirect measures should be tied to economic results, or outcomes, to calculate cost-effectiveness of different treatment options. Presentation of these connections usually

requires some kind of model with the use of epidemiological data to assess the probability of transition from one phase to another during the treatment. It is possible to determine the likelihood of hip fracture using bone density test in a different age, the likelihood of a heart attack or stroke with different blood pressure and cholesterol levels by age and sex. Ideally, we are interested in avoiding the consequences of events instead of avoiding the clinical event. Therefore, the outcomes are measured by preservation, and as well by improving quality of life.

Although survival may be given in many ways for the economic evaluation is usually measured using the number of years of life. When comparing the effects of two treatment options, the difference in expected survival between them is a measure of survival. Evidences of differences in survival are usually determined based on the results of clinical trials. Clinical trials rarely last long enough to provide complete information to calculate the difference in life expectancy between the treated and untreated groups. Table 1 presents the comparison of cost effectiveness of different health interventions.

Table 1. Cost-effectiveness of different health interventions

Intervention	Costs/years of life (in dollar value since 1993)
Small doses of lovastatin for cholesterol reduction	2.158
Males who survived heart attack, 55-64 years old, cholesterol level =250	2.293
Women, nonsmokers, 35-44 years old	2.023.440
An electrocardiogram, a test under the thrust applications, men of 40 years	124.374
An electrocardiogram, a test under the thrust applications, women of 40 years	335.217
Annual breast examination and mammography, women age 55-65 years	41.008
Doctors advice, smoking cessation rates by 1%, men 55-65 years old	3.777
Pap test for persons 20-74 years, every three years contrary to mistrust	24.011
Bypass coronary artery disease, illness of left main coronary artery	8.768
Single vessel disease with moderate angina pectoris	88.087
The units for neonatal intensive care, infants 1000-1500 grams	10.927
The units for neonatal intensive care, infants 500-999 grams	77.161

Source: [1, page: 300]

The data presented in Table 1 show large differences in cost effectiveness, from 2158 dollars per saved year of life (lovastatin small doses given to people with high cholesterol levels between age of 55 and 64) to 335,217 dollars for a cardiogram which is done

under load in order to detection of possible heart disease in women age 40 years.

Applicability of cost and effects analysis is lower in cases where the outcomes of certain treatment options are measured differently, or when a longer number

of different ways of measuring the effects exist. If one treatment option prevents premature death and the other reduces the number of days of illness, their comparison has unambiguously problematic nature. One way of solving this problem is to express the effect with the size of benefits. Analysis of cost-benefit (cost-utility analysis) is a subtype of costs and effects analysis. In its basis exist an indicator of QALY (quality adjusted life years), which determines the quality of life and level of health.

The concept of QALY is the first introduced in the study of chronic renal disease (12). The term was actually first used a decade later and has since become the measure of quality of life in the analysis of cost-effectiveness (13). The measure includes both the value of disease reduction (better quality of life) and mortality reduction (longer life).

QALY may be viewed as life expectancy with the preferred weight or quality of life related to each year. The quality of life is affected by many functional limitations, pain and suffering and the daily burden of disease. All this has an impact on the benefits of each additional year of life. It is normal that the extra year of life with the effects of certain disease have a lower value of additional years of life in perfect health. To use the QALY concept for presenting quality of life, quality must be linked to various health conditions. This quality is based on individual preferences for different health conditions, and on measured values of the interval from death (zero) to perfect health (equal to one). Perfect health, for example, is 1, death is zero, immobility, i.e. 0.3. Ten years in perfect health is 10 QALY's, the ten years of life in a stationary state is 10 times 0.3, equals 3 QALY's. The rule is to allocate resources in a way that provides the largest number of QALY's.

QALY estimates the average probability of life expectancy associated with each possible state of health. QALY was converted into a lifetime of health in a small number of years spent in perfect health.

Let us observe a 55-year-old man with type 2 diabetes. Complications of diabetes include other types of kidney disease, retinopathy, and damage to the nervous system that results in more than half of lower limb amputations in the United States. The risk of heart disease and stroke is two to four times higher for those with diabetes. Normally, the 55-year-old man could expect to live further 25 years, however, diabetes shortens the life expectancy by 10 years on average. Thus, 55 year old with diabetes can expect to live up to 70 year. Based on individual preferences, we assume that our subject gives the utility value of 0.4 for each of the remaining 15 years. His remaining 15 years has QALY value of 6 (15 x 0.4). Based on individual preferences, the total benefit of additional 15 years of age with type 2 diabetes is the same as the total benefit of additional 6 years of life with perfect health. Therefore, this man equals 15 years of age with diabetes, with 6 years of life with perfect health (2).

There are disagreements on issues about whose preferences should be measured when determining the QALY - of people who currently have a specific disease or of entire population. If people who are ill are interviewed (in this case those with type 2 diabetes), the questions would be to compare their current health to perfect health. If the general population is interviewed, the questions would be to rank the hypothetical medical condition described.

Most frequently mentioned constraint analysis of cost-benefit measurement method refers to the quality of life. World Health Organization defines quality of life in three dimensions of usefulness: the physical, mental and social. Using access to quality utility, Kaplan et al. (14) have developed a classification system with four attributes for patients: mobility, physical activities, social activities and symptom-problem complex. Dolan et al. (15) used the technique for measuring time preference bargain. This so-called EuroQol includes five health attributes: mobility, self care, usual activities, pain/discomfort and anxiety/depression, to define 245 possible health states. Both approaches are related to the QALY as a measure of the level of utility of various levels of medical conditions.

Macro-economic evaluation of health care

In the context of macro-economic evaluation of health care is an effort between the principle of relativization of conflict between efficiency principle and the principle of justice (equity) (16). The efficiency of the macro-economy is viewed mainly as allocation efficiency, which is achieved when none of the possible reorganizations of production can not improve the position of anyone, without jeopardizing someone else (17). The assumption of this type of macro-economic efficiency is the smooth functioning of the market. Note that we are talking about a theoretical model since the ideal of free markets do not exist in any sector of the economy. The causes that have resulted in the manifestation of market imperfections in health care are: the asymmetry of information, limited competition, non-profit nature of health care organizations, as well as the great influence of the insurance industry in health care (1).

The biggest reason for market imperfections in health care is imperfect information. Going to a doctor users are buying his knowledge and/or information. "As a patient, the consumer must rely on the assessment of doctors in relation to that which medication he needed, and whether the surgery or other interventions are recommended. Given that user has no knowledge of medicine, patients can not effectively assess their medical advice. They do not even have to be able to notice whether a doctor is qualified (1).

Unlike many other areas of the economy, the loss due to departure from perfect informing in the field of health care can be severe. In the economic literature,

as an illustration of this possibility, there is an often cited example of giant steel manufacturer Eben M. Byers who, a hundred years ago to help alleviate the symptoms drank something called Raditor, a substance which at that time was freely sold throughout the U.S. as an aphrodisiac and a cure for all ills. Later analysis showed that the Raditor was actually distilled water mixed with radium. Byers died in terrible agony, while his jaws and bones fell apart. Understandably, such role of the market is not needed by mankind (1).

The largest number of health institutions in the world belongs to the non-profit organizations. Nonprofit organizations are more numerous than for-profit health care, even in the U.S., as the paradigmatic example of a country whose economic system is based on free entrepreneurship model. These organizations simply do not see it as their goal to minimize the costs of providing services, and maximizing profits. The consequences of a lack of incentives such as profit exacerbate additionally the manner in which the government and private insurance companies compensate costs to individual health care institutions.

The problem that the insurance industry has, in the sense that individuals consume more health care than an optimum, is known in economics as a moral hazard. In short, moral hazard is the use of insider information in order to exploit the other party. Economists look at this problem, especially in light of the issues of incentives.

A particularly important cause of manifestation of market imperfections in health care relates to the issue of competition. When they see a doctor whose services' costs are lower, potential users may find that the services he provides have no demands and that with lower prices he is trying to attract users, and that he is not a good enough doctor. Another important aspect of the limited competition in health care refers to a wide variety of health services, which makes comparison of price and quality of service a sensitive issue. And this factor significantly restricts the free dissemination of information. Certain patients may be satisfied by specific medical services, but it is by no means a guarantee that other patients are satisfied. The fact that one doctor charged more than another one does not guarantee a competent assessment compared to a doctor who has lower rates of health services, and the like.

Efficiency as an economic concept can be determined as the ratio of outcomes (effects, income, benefits) and inputs (resources, costs). The healthcare system is effective when providing optimal quality health care at minimal cost compared to available resources. Frequently the macroeconomic efficiency of health care is viewed by examining the movement of health care costs in the gross domestic product. In Table 2 are given the latest data on the share of health expenditure in the amount of gross domestic product of fifteen developed OECD countries.

The share of health expenditure in the structure of GDP in most market economies in 2008 was at the level between 9 and 11%. The exception in this regard was the U.S., where it reached the amount of 16%. Health care costs in this economically leading country of the modern world even amounted to 7538 dollars per capita. It is measured by the criteria of the purchasing power of domestic currency, followed by Norway with 5003 dollars, Switzerland with 4627 dollars, Canada with 4079 dollars, and so on. It raises the question about the effectiveness of health care system in light of these growing costs. It is obvious that the increase in costs is largely a result of higher health care population of economically developed countries. However, there is a place for statement that the growth of health care costs does not reflect the normal functioning of competitive markets.

Equity in health care principle means that health services should be funded in accordance with the capacity of individuals and society. This is the principle of vertical equity in health care. The principle of horizontal equity in the provision of health care means that each individual receives an identical health services for equal health need.

Table 2. Health spending in 15 OECD countries in 2008

	In \$ expressed in purchasing power	% GDP
U.S.	7.538	16,0
Norway	5.003	8,9
Switzerland	4.627	10,8
Canada	4.079	10,1
Netherlands	4.063	9,8
Austria	3.970	10,1
Germany	3.737	10,4
France	3.696	11,0
Belgium	3.667	10,2
Sweden	3.470	9,1
Australia	3.353	8,7
United Kingdom	3.129	8,4
Spain	2.902	8,5
Italy	2.870	8,7
Japan	2.729	8,1

Source: OECD

CONCLUSION

Understanding the importance of economic evaluation of health care is in the function of raising the quality of the health care system as a whole and is an important assumption of current health care system reforms in most countries in the world.

Economic evaluation of health care is focused on exploring the relationship between costs and outcomes of alternative ways of providing health services. Given the fact that the costs in terms of methodology are a bit doubtful economic category, it follows that the key issues related to economic evaluation are related to quantification of health care outcomes.

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OSVRT NA EKONOMSKU EVALUACIJU ZDRAVSTVENE ZAŠTITE

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Sažetak

Polazeći od redukovane definicije zdravlja, u smislu odsustva bolesti i invalidnosti, u radu se objašnjava primenljivost tri kardinalna načela ekonomske nauke (oskudnost resursa i imperativ izbora, oportunitetni troškovi, marginalna analiza) na krajnje osetljivo područje ekonomske evaluacije zdravstvene zaštite.

Učinjen je pokušaj prepoznavanja jakih strana i identifikovanja objektivnih ograničenja najčešće primenjivanih metoda ekonomske evaluacije zdravstvene zaštite. Rad se koncentriše na prepoznavanje glavnih problema, apstrahujući pri tom mnoge detalje.

Ključne reči: zdravlje, zdravstvena zaštita, ekonomska evaluacija, efikasnost, pravednost